

Acronyms and Abbreviations

⁴⁰ K	potassium-40, an isotope of potassium
ABMA	Army Ballistic Mission Agency
AGU	American Geophysical Union
AIAA	American Institute of Aeronautics and Astronautics
ASC	Astro Sciences Center; part of IITRI
ASI	atmospheric structure instrument
AU	Astronomical Unit (distance from Earth to the Sun)
BMFT	Bundesministerium fuer Forschung und Technologie
Caltech	California Institute of Technology
CB	Citizens Band
CCD	charge-coupled device
CFC	chlorofluorocarbon
CH ₄	methane
COMPLEX	Committee on Planetary and Lunar Exploration
DC	direct current
DDS	dust detection system
DOD	Department of Defense
DOE	Department of Energy
DPS	Division for Planetary Sciences
DSN	Deep Space Network
EDT	eastern daylight time
EGA	Earth gravity-assist
EGS	European Geophysical Society
EPD	energetic particles detector
EPI	energetic particles instrument
ESRO	European Space Research Organization
ESTEC	European Space Research and Technology Centre
EUG	European Union of Geosciences
EUV	extreme ultraviolet
FEIS	final environmental impact statement
FSAR	final safety analysis report
FY	Fiscal Year
GAO	General Accounting Office
GC	gas chromatograph
GC/MS	gas chromatograph–mass spectrometer
GEM	Galileo Europa Mission
GMM	Galileo Millennium Mission
GMT	Greenwich mean time

GPO	Government Printing Office
H ₂	molecular hydrogen
H ₂ O	water
H ₃	hydrogen isotope
HAD	helium abundance detector
HEOS	Highly Eccentric Orbit Satellite
HGA	high-gain antenna
HST	Hubble Space Telescope
HUD	Housing and Urban Development
IITRI	Illinois Institute of Research Technology Research Institute
INSRP	Interagency Nuclear Safety Review Panel
IRAS	Infrared Astronomy Satellite
IRD	Interface Requirements Document
IUS	Interim Upper Stage; later, Inertial Upper Stage
JOI	Jupiter Orbit Insertion
JOP	Jupiter Orbiter Probe
JOPSWG	JOP science working group
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
keV	thousand (kilo) electron volts
KSC	Kennedy Space Center
LED	light-emitting diodes
LEMMS	low-energy magnetospheric measurements system
LGA	low-gain antenna
LRD	lightning and radio emissions detector
MeV	million electron volts
mph	miles per hour
N ₂ O	nitrous oxide
NASA	National Aeronautics and Space Administration
NEP	nephelometer
NEPA	National Environmental Policy Act
NFR	net flux radiometer
NH ₃	ammonia
NH ₄ SH	ammonium hydrosulfide
NIMS	near infrared mapping spectrometer
NMS	neutral mass spectrometer
NO ₃	oceanic nitrate
NOAA	National Oceanic and Atmospheric Administration
NSSDC	National Space Science Data Center
OMB	Office of Management and Budget
PDT	Pacific daylight time
PLS	plasma subsystem

PPR	photopolarimeter radiometer
psi	pounds per square inch
PST	Pacific standard time
PWS	plasma wave subsystem
RF	radio frequency
RFP	Request for Proposal
R_j	Jupiter radii
RPM	retropropulsion module (part of the Jupiter Orbiter)
rpm	revolutions per minute
RTG	radioisotope thermal generator
S/L-9	Comet Shoemaker-Levy 9
SAF	Spacecraft Assembly Facility (JPL)
SAG	Science Advisory Group
SAR	safety analysis report
SBA	spin bearing assembly
SEC	Sun-Earth-Craft
SEDS	Students for the Exploration and Development of Space
SETI	Search for Extraterrestrial Intelligence
SITURNS	spacecraft inertial turns, also called science turns
SOE	sequence of events
SOPE	Strategy for Outer Space Exploration
SRM	solid rocket motor
SSI	solid state imaging
Star Wars	nickname for the Strategic Defense Initiative
TCM	trajectory correction maneuver
TDM	time division multiplex
TDRS	Tracking and Data Relay Satellite
TOPS	Thermoelectric Outer Planet Spacecraft
U.S.	United States
UCAR	University Corporation for Atmospheric Research
UCLA	University of California, Los Angeles
UT	universal time
UV	ultraviolet
UVS	ultraviolet spectrometer
VEEGA	Venus-Earth-Earth gravity-assist
VLF	Very Low Frequency
VOIR	Venus Orbiter Imaging Radar

Index

Note: Terms such as “NASA,” “Jet Propulsion Laboratory (JPL),” “Orbiter,” and “Probe” are not included because of their high frequency.

A

Adrastea 256, 277–278
Aftergood, Steven 98
Air Force 12, 33, 47, 50, 54–58, 65, 105,
149–150, 183, 290
Aldrich, Arnold 85
Alexander, Claudia xix, 281–282, 285
Allnut, Robert 57, 59
Amalthea xi, 238, 256, 259, 277–280
Ames Research Center (Ames, ARC) vi, xix, 5,
11–12, 20–22, 26–27, 30–33, 38–39, 61, 111,
115–117, 121–122, 124–126, 128, 150, 195,
200–201, 203–206, 216–217, 291
Amphitrite 45, 66–68, 76, 83, 104
Antarctica (antarctic) 160, 166, 265–266, 295
Apollo xviii, 4, 11, 16, 19–22, 24, 26, 85,
98–99, 114, 158, 284, 287
Army Ballistic Missile Agency (ABMA) 10,
13–14, 284
Atlantis v, vii, 45, 70, 78, 100, 103–105, 149, 289
Atlas 14–15, 65
atmospheric structure instrument (ASI) 39,
121–123, 125, 206–207, 210, 221
Atomic Energy Commission 98
Ausonia 94, 104
autonomous spacecraft 50–51

B

Baker, James 54
Beggs, James 45, 52, 57–58, 67–68
Boeing 33, 43–44, 47, 54–55, 58, 65
Boland, Eddie 35, 43, 45–47, 80
bow shock vi–vii, 20, 129, 134, 154–55,
157–158, 201–202, 270
Bureau of the Budget 24–26
Bush, George 49, 75, 100, 102
Byrnes, Dennis 157, 293–294

C

Callisto xiii, 136, 139, 144, 148, 186, 209, 224,
231–233, 236, 251, 255, 259, 268, 273–277

Carter, Jimmy 49
Casani, John xv, xix, xxi, 5–7, 32, 37–38,
44–45, 49, 50–51, 53–56, 58–60, 62, 66–70,
81–83, 93–94, 105, 108, 111, 115, 182–183,
224, 283–287, 289, 294
Centaur 12, 15, 31–33, 42–48, 51–60, 63, 65–66,
70, 76–77, 79–83, 93, 103–104, 266, 286, 289,
293
Challenger v, xiii, 3, 45, 70–97, 103–104, 177,
286, 289–290, 293, 299
Christic Institute 97, 102
Chyba, Christopher 211, 261, 264
cleanroom 62
comet ix, 4, 7, 48, 51, 53, 66, 149, 187–193, 196,
210–211, 215, 239, 259–261, 267, 273, 277,
296, 300
Committee to Bridge the Gap 97–98, 100
COMPLEX 12, 31–32
Congress (U.S.) v, xv, xix, 9, 11–12, 16, 19–21,
24–27, 28–29, 34–38, 43–48, 52, 56–59, 69,
80, 86, 95, 182, 284–285, 288, 299–300
Convair 44–45, 58
Cox, Nagin xix, xxi, 226, 237, 246–248, 250,
256–257, 296–298

D

Dactyl viii, 3, 168–169
D’Amario, Louis 82, 152, 157, 293–294
deceleration module ix, 61, 115–117, 205
Deep Space Network (DSN) 3, 108, 139–140,
151, 186, 227–228, 230, 266, 282
Department of Defense (DOD) 44, 50, 53–55,
78, 87, 96–97
Department of Energy (DOE) xv, 5, 78, 96–100
descent module vi, ix, 61, 115–117, 205, 207
Diehl, Roger 157, 293–294
dual-spin design 34, 112–114
dust x, 4–5, 8, 21, 29, 41, 51, 67, 109, 127,
130–133, 187–188, 192–193, 195–197, 211,
215, 237, 245, 254, 277, 300
dust detector system (DDS) 41, 67, 109,
130–133, 195–197

E

electromagnetic x, 40, 63, 68, 127, 131,
 138–141, 143, 155, 193, 196–197, 233, 270
 energetic particle detector (EPD) vii, 130–136
 energetic particle instrument (EPI) 121–123, 126–
 127, 202, 206
 Environmental Protection Agency (EPA) 96
 Erickson, Jim xix, 237, 240, 247–251, 255–257,
 259, 269, 274, 277, 282, 285, 290, 294–295
 Europa x, xi, xiii, xvii, 4, 136, 139, 144, 148, 185,
 200–203, 209, 224, 231–238, 240, 242, 246, 250,
 252–269, 271–272, 275–279, 281–282, 292, 295,
 297, 299–300
 Europe xv, xviii, 6–7, 12, 18, 29–31, 40, 50–51, 59,
 193, 229, 280, 292
 Evans, David 50

F

Flandro, Gary 18–19, 22, 29
 Fletcher, James 8, 11, 25, 27–28, 35, 69, 79
 Florida Coalition for Peace and Justice 96, 100–102
 flyby 3–5, 9, 10–12, 16–18, 20–24, 27–30, 44–45,
 66–67, 83, 93, 99, 108, 126, 129–131, 137, 151–
 158, 161, 163–164, 166, 168–169, 171, 180–181,
 186, 202–203, 209–210, 221, 223–281, 292, 296
 Ford, Gerald 31, 34
 Frank, Louis 40, 132, 155, 245, 251
 Frank, Steve 101
 Frosch, Robert 43, 45–48

G

Gagnon, Bruce 96–97, 100
 Galilean moons (Galilean satellites) 1, 38, 136,
 139, 144, 148, 202, 223–224, 231, 242, 253, 260,
 267–270, 272–275, 278–279, 285
 Galileo Europa Mission (GEM) x, xiii, 233–237,
 240, 246, 248, 256–258, 274, 278–279, 297
 Galileo Galilei xxi, 1, 2, 38, 223–225, 243, 253,
 267, 275
 Galileo Millennium Mission (GMM) x, xiii, 228,
 233, 237–241, 249–253, 255, 258, 269–270, 274,
 280–281
 Ganymede xiii, 4, 136, 139, 144, 148, 197, 209,
 224, 231–233, 242, 249–250, 255, 259, 261, 266–
 267–273, 275–276
 gas chromatograph (GC) 120

gas chromatograph–mass spectrometer (GCMS) 120
 Gasch, Oliver 101–102
 Gaspra vii, viii, ix, 3, 94, 104, 136, 161–164, 166–169,
 171, 180, 188
 General Dynamics 44–45, 58, 65
 geocorona viii, 164–166, 169
 Germany xv, xviii, 5–6, 31, 38, 41, 49, 101, 111,
 122, 124, 126, 131, 135, 193, 195–197, 289–291
 Glenn Research Center (also see Lewis Research
 Center) 5, 59
 Goddard Space Flight Center (GSFC) 4, 10, 16,
 21–22, 29, 31, 39–40, 119–123, 125–126, 131,
 133, 135–136, 142, 144, 154, 190, 218, 266–267
 Goldin, Daniel 263–264, 287
 Grand Tour 11–12, 17–19, 21–29, 34
 gravity waves 139–140
 gravity-assist v, viii, ix, 18, 26, 29, 30, 41–44, 47–48,
 54–56, 59, 82, 84, 103, 150, 157–158, 168, 187–
 188, 230–231, 236, 241, 267–269, 286, 293
 Greens 101
 Guastaferrro, Angelo 43

H

Halley's Comet 7, 48, 51, 192
 Hardy, George 72
 Hearth, Donald 18–19
 heatshield vi, ix, 12, 29–30, 61, 103, 116–117, 127,
 201, 204–205, 207
 helium 2, 4, 39, 61, 120, 122–124, 202, 211, 213–215
 helium abundance detector (HAD) 120–125
 Herman, Dan 33–34
 Hibbs, Albert 10
 high-gain antenna (HGA) viii, 3, 93, 103, 109,
 130, 152, 161, 171–187, 195, 197, 228–229, 288,
 294–296
 House of Representatives 7, 11–13, 27, 34–35, 38,
 45–46, 58, 78, 80, 85–86, 108
 Hubble Space Telescope 12–13, 34–35, 79, 87,
 191–193, 244, 266, 278
 Hughes Aircraft Company, Hughes Space and
 Communications Company 5, 33–34, 61–63, 81,
 121–122, 125–126, 291
 hydrogen v, viii, 2, 15, 29, 33, 39, 42–43, 47–48,
 58, 65–66, 75–76, 79–80, 89, 103, 120, 122,
 124–125, 135, 164–166, 192, 211, 214–219, 264, 266

I

- ice (extraterrestrial) vi, x, xi, 4, 125, 128, 139, 146, 188, 192, 211–213, 215–216, 234–236, 250, 253–277, 280, 282, 292, 295, 299
- ice (terrestrial, including ice on Challenger) xi, 73, 159, 166, 265–266, 295
- Ida viii, ix, 3, 94, 104, 136, 166–169, 187–188
- Inertial Upper Stage (IUS) v, vii, 33, 37, 41–48, 54–59, 65, 80–81, 93, 103–105, 111, 149–152, 178
- infrared vi, x, 17, 39, 67, 121, 125–126, 128, 141–145, 147, 151–153, 156, 159–160, 164, 166, 191, 212, 218–219, 225, 241, 247–249, 252, 256, 271, 278, 280–281
- injection module 44, 54, 57, 60
- International Court of Justice 101
- interplanetary dust 4, 131, 187, 195–197, 300
- Io xiii, 2, 4, 29, 127, 134–139, 144, 147–148, 185, 195–197, 200–203, 209, 224, 226–228, 231–253, 256–259, 268–269, 274–275, 277, 279, 288, 292, 295–296, 298–300

J

- Japan 7, 50–51
- Johnson Space Center (JSC) v, vi, 5, 74, 76, 116
- Johnson, Lyndon 16, 19–20, 24–25
- Johnson, Torrence (T.V.) xvii–xix, 1–3, 31, 36, 50, 88, 109–110, 119–120, 130–131, 141–142, 152–154, 156, 184, 199, 223, 239, 241–242, 245, 251, 270, 273, 277, 280–282, 288
- Joint Environment Simulator v, 88–89
- Jupiter Orbiter Insertion (JOI) 111, 203, 208–209, 225, 231, 292
- Jupiter Orbiter Probe (JOP) 12–13, 30–38, 43, 109–110, 284, 288
- Jupiter Orbiter Probe Science Working Group (JOPSWG) 33, 109–110, 119–120
- Justice Department 101

K

- Kennedy Space Center (KSC) 5, 42, 45, 51, 60, 69–70, 72–75, 77, 81, 93–94, 100–104, 149–150, 177–178, 183, 284
- Kennedy, John 16, 19, 25
- Keyworth, George 44, 52–53
- Kivelson, Margaret 40, 131, 135, 154–156, 164, 196, 201, 243, 251–252, 261–263, 270–271, 276

L

- Ladish Company 86
- Lake Vostok 265–266
- lander 10, 17, 114–115, 120, 153, 291
- Langley Research Center 115, 266
- Lanzerotti, Louis 39, 122, 126, 155, 221
- Levanas, Greg xix, 281–282
- Levy, Eugene 53
- Lewis Research Center 5, 58–59, 62, 172, 176–177
- life (extraterrestrial) 4, 124, 148, 215, 238, 252, 261, 263–266, 277, 281, 283, 292, 295, 300
- life (terrestrial) 124, 159–161
- lightning (Jovian) 4, 39, 121–122, 124, 126, 146, 201, 210, 213, 220–221
- lightning (Venusian) 153–157
- lightning and radio emissions detector (LRD) 121–123, 126–127, 210, 220
- Lockheed 10, 15
- Lopes-Gautier, Rosaly 241, 253
- low-gain antenna (LGA) viii, 93, 103, 130, 152, 161, 176, 180–181, 184–186, 195, 197, 204, 225, 228–229, 296
- Lowery, Bill 58
- Lund, Robert 72

M

- Magellan 52, 80–81, 156
- magnetic field vi, vii, xviii, 1–4, 10, 17, 21, 29, 38–40, 108–109, 111–113, 126–127, 130–139, 148, 154–158, 164, 167, 169, 184, 186, 193, 196, 201, 234–239, 243–244, 249, 251–252, 256, 259, 262–263, 267–271, 274, 276–280
- magnetometer (MAG) 40, 95, 108, 112, 130–132, 135–137, 201, 262, 269, 276
- magnetosphere vi, vii, 40, 107, 109, 121, 129, 131–139, 142, 154, 158, 164, 201, 223, 245, 251, 256–258, 261–262, 266, 269–271, 274, 276
- Malow, Dick xix, 34–35, 46
- Mariner 12, 16, 20, 27–32, 67, 166, 284, 288, 291
- Mark, Hans 51
- Markey, Edward 78
- Marshall Space Flight Center 10, 16, 22, 72, 79, 84–85, 87, 90, 265
- Maryland Safe Energy Coalition 100
- mass spectrometer 39, 120–124, 137, 210, 215–216
- McDonald, Al xix, 72–75, 86–87
- Meese, Edwin 52

Metis xi, 256, 259, 277–279

Minovitch, Michael 18

Mitchell, Bob xix, 18, 52, 255–256, 261–263, 268, 278, 285, 293–294

Moon (of Earth) x, xvii, 2, 4, 10, 19–20, 85, 93, 98, 114, 135, 138, 148, 157–158, 166, 168–169, 190, 224, 239, 241–242, 259, 261, 271, 276, 284, 291

Moore, Jesse 42

Morton Thiokol 71–73, 79, 85–91

Murray, Bruce 19, 28, 32–33, 36, 46–47, 50, 57

Murray, Robert 182

N

National Academy of Sciences 10–12, 16–17, 25–27, 31–32, 49, 52–53

National Environmental Policy Act (NEPA) 101–103

National Oceanic and Atmospheric Administration (NOAA) 40, 96

National Research Council 87–90

National Space Council 101

near infrared mapping spectrometer (NIMS) vii, 39, 109, 130, 141–144, 147, 151, 153, 159, 164, 166, 168, 191–192, 218, 241, 246, 248–249, 261, 274, 278

nephelometer (NEP) 39, 121–123, 125–126, 213

net flux radiometer (NFR) 121–123, 127–128, 210, 212–213, 216

neutral mass spectrometer (NMS) 120–126, 210, 213, 215–216

Newburn, Ray 9, 10, 13, 190

Nixon, Richard 11–12, 24–27, 31

Nuclear Regulatory Commission 96

O

Office of Management and Budget (OMB) 11–12, 25–26, 34, 44, 48–49, 52, 54, 57, 299

O’Keefe, Sean 282

O’Neil, William (Bill) 180–182, 184, 186, 194, 198–202, 245, 247, 255, 268–269, 282, 285, 291–292, 294

Orbital Science Corporation 81

O-ring 71–74, 90–92, 94–95

Orr, Verne 58

Outer Planets Working Group 11, 22–24

oxygen v, 15, 65–66, 75–76, 80, 89, 134, 159–161, 192, 210–211, 215, 245, 264, 266

ozone 148, 159, 166, 168, 288

P

Paine, Thomas 25–26

parachute ix, 44, 50, 61–62, 117, 204–205, 207–208, 291

photopolarimeter radiometer (PPR) vii, 40, 109, 130, 141–142, 144–147, 241, 247, 274

Pioneer (spacecraft) 11–13, 20–23, 26–32, 37, 84, 95, 108, 114, 119–121, 131, 136–137, 155–156, 245, 284

plasma subsystem vii, 40, 109, 127, 130–132, 137–138, 154

plasma wave subsystem (PWS) 40, 109, 121, 130–132, 137–139, 153–156, 270

plutonium 5, 64, 69, 77–78, 83, 97–101, 104, 111

Presidential Commission (also see Rogers Commission) 71, 75, 79, 87, 91

Prime Mission x, xiii, 149, 231–234, 236, 240, 246, 255–257, 268, 295, 297

Q

Quayle, Dan 101

R

radioisotope thermal generator (RTG) 15, 22, 64, 77–78, 81, 83, 97–100, 109, 111, 114–116, 130, 289

Reagan, Ronald 44, 48–49, 51–52, 54, 58, 76, 79, 285–286

Rogers, William and the Rogers Commission 71–80, 84, 86–87, 91

S

Sagan, Carl 159–161

Schmitt, Harrison 58

Schubert, Gerald 213, 244, 276

Science Advisory Group (SAG) 11–12, 27, 29–30

Search for Extra-Terrestrial Intelligence (SETI) Institute 263–264, 277

Senate xxi, 7, 11, 13, 27, 34–35, 41, 44, 46, 50, 58, 99

Shoemaker-Levy comet ix, 4, 187–193, 196, 210, 259–260, 296, 300

Sinkin, Larry 97

Sobeck, Charlie xix, 121–122, 125–126

solar conjunction x, 225, 232–233, 249–250, 255–257

solar wind vi, vii, xiii, 21, 29, 40, 133–136, 154–158, 164, 167, 169, 201–202, 211, 213, 237–239, 269–270

solid rocket motor (SRM) 72, 79, 86–87, 90–93
 solid state imaging camera (SSD) vii, xi, 142, 146–148, 151, 153–154, 156, 160, 162, 185, 227, 229, 241, 244, 246, 248, 253, 274, 278–280, 297
 Soviet Union (Soviet) 7, 16, 25, 50–51, 153, 155, 265–266
 Space Science Board (SSB) 11, 16, 25–27, 31, 34, 53
 Space Science Steering Committee 38
 Space Shuttle (Shuttle) v, xiii, 3, 5, 12, 27, 29–31, 33, 35, 37, 41–48, 51, 53–58, 62–66, 69–74, 76–81, 83–93, 96, 99–105, 115, 149, 172, 175, 178, 286, 289, 293
 spectrometer 15, 39–43, 109–110, 120–124, 130, 137, 141–144, 147–148, 151, 153, 159, 164, 191, 210, 215–216, 241, 253, 271, 278
 Spehalski, R.J. xix, 5, 105, 285–286, 289–291, 293
 Sperans, Joel xix, 61, 120
 spin-stabilized 11, 20–21, 26, 34
 Stewart, Homer Joe 18
 Stockman, David 44, 49–50, 53–54
 Straly, Warren 13–14
 Stuhlinger, Ernst 14
 sun shield vii, 93, 103, 130, 150, 152, 171, 180

T

tape recorder 3, 93, 147, 151–152, 185, 187, 197–200, 209, 225–226, 229, 236, 240, 245–246, 250–253, 255–259, 280–282, 285, 292
 Thebe xi, 256, 259, 277–279
 Theilig, Eilene xix, 223, 237–238, 240, 246, 248–249, 251–253, 282, 285, 295–296
 thermal blanket 64, 103, 111, 114
 Thermoelectric Outer Planet Spacecraft (TOPS) 12, 26–28
 Thompson, James 85, 90
 three-axis-stabilized 11, 20, 26, 34
 Thurmond, Strom 44, 50–51
 Titan (launch vehicle) 15, 31–32, 42, 47, 81, 88
 Titan (satellite of Saturn) 29, 81, 88, 263
 trajectory correction maneuver (TCM) 63, 151–152, 157, 164
 Transit navigational satellite 98
 Truly, Richard 85

U

UCLA xix, 18, 40, 131–132, 137, 142, 164, 201, 243, 257, 262, 270–271, 276
 ultraviolet spectrometer (UVS) 40, 109, 130, 142, 147–148, 164, 191, 278

V

Van Allen belts 53, 202
 Van Allen, James 22, 33, 53, 69, 109, 119
 VEEGA trajectory v, 83–84, 93–94, 103, 150, 157, 187–188, 286, 293–294
 Venus v, vii, ix, xvii, 1, 7, 16, 26, 32, 48, 51–52, 80, 83–84, 93–95, 103–104, 119–121, 136, 148–157, 187–188, 284, 286, 293–294
 Viking 25, 31–32, 36, 81, 114, 120, 291
 volcano (volcanism, volcanic) v, x, xvii, 2, 4, 127, 148, 156, 166, 169, 195, 197, 234–236, 239–253, 258–259, 261, 263, 265, 268, 272–273, 288, 300
 von Braun, Wernher 84, 283–284, 287
 Voss, Robert G. 13–14
 Voyager xvii, xviii, 3–4, 7, 12, 16–19, 21–29, 31–32, 37, 51–52, 69, 81–83, 108–109, 111, 114, 121, 124, 126, 131–132, 134–138, 141, 146–147, 191, 197, 200, 210–211, 214–217, 221, 228, 245, 250, 254, 261, 272, 278, 284–285

W

Waff, Craig xix, 10, 13–36, 41, 48–51, 53–55, 57–58, 110
 Wald, Patricia 103
 water x, xi, 4, 73, 92, 98, 124, 154, 159, 161, 166, 192–193, 201, 210–220, 234–239, 253–267, 269, 271–272, 277, 282, 292, 295
 Webb, James 20
 Weinberger, Caspar 54
 Welch, Jasper 57
 whistler 126, 155–158
 White House 19–20, 44, 48, 51–55, 57, 75, 86, 100, 299
 White Sands Missile Range 61
 Wolfe, Al 50, 60

NASA History Series

Reference Works, NASA SP-4000

Grimwood, James M. *Project Mercury: A Chronology*. NASA SP-4001, 1963.

Grimwood, James M., and C. Barton Hacker, with Peter J. Vorzimmer. *Project Gemini Technology and Operations: A Chronology*. NASA SP-4002, 1969.

Link, Mae Mills. *Space Medicine in Project Mercury*. NASA SP-4003, 1965.

Astronautics and Aeronautics, 1963: Chronology of Science, Technology, and Policy. NASA SP-4004, 1964.

Astronautics and Aeronautics, 1964: Chronology of Science, Technology, and Policy. NASA SP-4005, 1965.

Astronautics and Aeronautics, 1965: Chronology of Science, Technology, and Policy. NASA SP-4006, 1966.

Astronautics and Aeronautics, 1966: Chronology of Science, Technology, and Policy. NASA SP-4007, 1967.

Astronautics and Aeronautics, 1967: Chronology of Science, Technology, and Policy. NASA SP-4008, 1968.

Ertel, Ivan D., and Mary Louise Morse. *The Apollo Spacecraft: A Chronology, Volume I, Through November 7, 1962*. NASA SP-4009, 1969.

Morse, Mary Louise, and Jean Kernahan Bays. *The Apollo Spacecraft: A Chronology, Volume II, November 8, 1962–September 30, 1964*. NASA SP-4009, 1973.

Brooks, Courtney G., and Ivan D. Ertel. *The Apollo Spacecraft: A Chronology, Volume III, October 1, 1964–January 20, 1966*. NASA SP-4009, 1973.

Ertel, Ivan D., and Roland W. Newkirk, with Courtney G. Brooks. *The Apollo Spacecraft: A Chronology, Volume IV, January 21, 1966–July 13, 1974*. NASA SP-4009, 1978.

Astronautics and Aeronautics, 1968: Chronology of Science, Technology, and Policy. NASA SP-4010, 1969.

Newkirk, Roland W., and Ivan D. Ertel, with Courtney G. Brooks. *Skylab: A Chronology*. NASA SP-4011, 1977.

Van Nimmen, Jane, and Leonard C. Bruno, with Robert L. Rosholt. *NASA Historical Data Book, Volume I: NASA Resources, 1958–1968*. NASA SP-4012, 1976, rep. ed. 1988.

Ezell, Linda Neuman. *NASA Historical Data Book, Volume II: Programs and Projects, 1958–1968*. NASA SP-4012, 1988.

Ezell, Linda Neuman. *NASA Historical Data Book, Volume III: Programs and Projects, 1969–1978*. NASA SP-4012, 1988.

Gawdiak, Ihor Y., with Helen Fedor, compilers. *NASA Historical Data Book, Volume IV: NASA Resources, 1969–1978*. NASA SP-4012, 1994.

Rumerman, Judy A., compiler. *NASA Historical Data Book, 1979–1988: Volume V, NASA Launch Systems, Space Transportation, Human Spaceflight, and Space Science*. NASA SP-4012, 1999.

Rumerman, Judy A., compiler. *NASA Historical Data Book, Volume VI: NASA Space Applications, Aeronautics and Space Research and Technology, Tracking and Data Acquisition/Space Operations, Commercial Programs, and Resources, 1979–1988*. NASA SP-2000-4012, 2000.

Astronautics and Aeronautics, 1969: Chronology of Science, Technology, and Policy. NASA SP-4014, 1970.

Astronautics and Aeronautics, 1970: Chronology of Science, Technology, and Policy. NASA SP-4015, 1972.

Astronautics and Aeronautics, 1971: Chronology of Science, Technology, and Policy. NASA SP-4016, 1972.

Astronautics and Aeronautics, 1972: Chronology of Science, Technology, and Policy. NASA SP-4017, 1974.

Astronautics and Aeronautics, 1973: Chronology of Science, Technology, and Policy. NASA SP-4018, 1975.

Astronautics and Aeronautics, 1974: Chronology of Science, Technology, and Policy. NASA SP-4019, 1977.

Astronautics and Aeronautics, 1975: Chronology of Science, Technology, and Policy. NASA SP-4020, 1979.

Astronautics and Aeronautics, 1976: Chronology of Science, Technology, and Policy. NASA SP-4021, 1984.

Astronautics and Aeronautics, 1977: Chronology of Science, Technology, and Policy. NASA SP-4022, 1986.

Astronautics and Aeronautics, 1978: Chronology of Science, Technology, and Policy. NASA SP-4023, 1986.

Astronautics and Aeronautics, 1979–1984: Chronology of Science, Technology, and Policy. NASA SP-4024, 1988.

Astronautics and Aeronautics, 1985: Chronology of Science, Technology, and Policy. NASA SP-4025, 1990.

Noordung, Hermann. *The Problem of Space Travel: The Rocket Motor*. Edited by Ernst Stuhlinger and J. D. Hunley, with Jennifer Garland. NASA SP-4026, 1995.

Gawdiak, Ihor Y., Ramon J. Miro, and Sam Stueland, comps. *Astronautics and Aeronautics, 1986–1990: A Chronology*. NASA SP-4027, 1997.

Gawdiak, Ihor Y. and Shetland, Charles. *Astronautics and Aeronautics, 1990–1995: A Chronology*. NASA SP-2000-4028, 2000.

Orloff, Richard W. *Apollo by the Numbers: A Statistical Reference*. NASA SP-2000-4029, 2000.

Management Histories, NASA SP-4100

Rosholt, Robert L. *An Administrative History of NASA, 1958–1963*. NASA SP-4101, 1966.

Levine, Arnold S. *Managing NASA in the Apollo Era*. NASA SP-4102, 1982.

Roland, Alex. *Model Research: The National Advisory Committee for Aeronautics, 1915–1958*. NASA SP-4103, 1985.

Fries, Sylvia D. *NASA Engineers and the Age of Apollo*. NASA SP-4104, 1992.

Glennan, T. Keith. *The Birth of NASA: The Diary of T. Keith Glennan*. J. D. Hunley, editor. NASA SP-4105, 1993.

Seamans, Robert C., Jr. *Aiming at Targets: The Autobiography of Robert C. Seamans, Jr.* NASA SP-4106, 1996.

Garber, Stephen J., editor. *Looking Backward, Looking Forward: Forty Years of U.S. Human Spaceflight Symposium*. NASA SP-2002-4107, 2002.

Mallick, Donald L. with Peter W. Merlin. *The Smell of Kerosene: A Test Pilot's Odyssey*. NASA SP-4108, 2003.

Iliff, Kenneth W. and Curtis L. Peebles. *From Runway to Orbit: Reflections of a NASA Engineer*. NASA SP-2004-4109, 2004.

Chertok, Boris. *Rockets and People, Volume 1*. NASA SP-2005-4110, 2005.

Chertok, Boris. *Rockets and People: Creating a Rocket Industry, Volume II*. NASA SP-2006-4110, 2006.

Laufer, Alexander, Todd Post, and Edward Hoffman. *Shared Voyage: Learning and Unlearning from Remarkable Projects*. NASA SP-2005-4111, 2005.

Dawson, Virginia P. and Mark D. Bowles. *Realizing the Dream of Flight: Biographical Essays in Honor of the Centennial of Flight, 1903–2003*. NASA SP-2005-4112, 2005.

Project Histories, NASA SP-4200:

Swenson, Loyd S., Jr., James M. Grimwood, and Charles C. Alexander. *This New Ocean: A History of Project Mercury*. NASA SP-4201, 1966; rep. ed. 1998.

Green, Constance McLaughlin, and Milton Lomask. *Vanguard: A History*. NASA SP-4202, 1970; rep. ed. Smithsonian Institution Press, 1971.

Hacker, Barton C., and James M. Grimwood. *On the Shoulders of Titans: A History of Project Gemini*. NASA SP-4203, 1977.

Benson, Charles D., and William Barnaby Faherty. *Moonport: A History of Apollo Launch Facilities and Operations*. NASA SP-4204, 1978.

Brooks, Courtney G., James M. Grimwood, and Loyd S. Swenson, Jr. *Chariots for Apollo: A History of Manned Lunar Spacecraft*. NASA SP-4205, 1979.

Bilstein, Roger E. *Stages to Saturn: A Technological History of the Apollo/Saturn Launch Vehicles*. NASA SP-4206, 1980, rep. ed. 1997.

SP-4207 not published.

Compton, W. David, and Charles D. Benson. *Living and Working in Space: A History of Skylab*. NASA SP-4208, 1983.

Ezell, Edward Clinton, and Linda Neuman Ezell. *The Partnership: A History of the Apollo–Soyuz Test Project*. NASA SP-4209, 1978.

Hall, R. Cargill. *Lunar Impact: A History of Project Ranger*. NASA SP-4210, 1977.

Newell, Homer E. *Beyond the Atmosphere: Early Years of Space Science*. NASA SP-4211, 1980.

Ezell, Edward Clinton, and Linda Neuman Ezell. *On Mars: Exploration of the Red Planet, 1958–1978*. NASA SP-4212, 1984.

- Pitts, John A. *The Human Factor: Biomedicine in the Manned Space Program to 1980*. NASA SP-4213, 1985.
- Compton, W. David. *Where No Man Has Gone Before: A History of Apollo Lunar Exploration Missions*. NASA SP-4214, 1989.
- Naugle, John E. *First Among Equals: The Selection of NASA Space Science Experiments*. NASA SP-4215, 1991.
- Wallace, Lane E. *Airborne Trailblazer: Two Decades with NASA Langley's Boeing 737 Flying Laboratory*. NASA SP-4216, 1994.
- Butrica, Andrew J., editor. *Beyond the Ionosphere: Fifty Years of Satellite Communication*. NASA SP-4217, 1997.
- Butrica, Andrew J. *To See the Unseen: A History of Planetary Radar Astronomy*. NASA SP-4218, 1996.
- Mack, Pamela E., editor. *From Engineering Science to Big Science: The NACA and NASA Collier Trophy Research Project Winners*. NASA SP-4219, 1998.
- Reed, R. Dale, with Darlene Lister. *Wingless Flight: The Lifting Body Story*. NASA SP-4220, 1997.
- Heppenheimer, T. A. *The Space Shuttle Decision: NASA's Search for a Reusable Space Vehicle*. NASA SP-4221, 1999.
- Hunley, J. D., editor. *Toward Mach 2: The Douglas D-558 Program*. NASA SP-4222, 1999.
- Swanson, Glen E., editor. *"Before this Decade Is Out . . .": Personal Reflections on the Apollo Program*. NASA SP-4223, 1999.
- Tomayko, James E. *Computers Take Flight: A History of NASA's Pioneering Digital Fly-by-Wire Project*. NASA SP-2000-4224, 2000.
- Morgan, Clay. *Shuttle-Mir: The U.S. and Russia Share History's Highest Stage*. NASA SP-2001-4225, 2001.
- Leary, William M. *"We Freeze to Please": A History of NASA's Icing Research Tunnel and the Quest for Flight Safety*. NASA SP-2002-4226, 2002.
- Mudgway, Douglas J. *Uplink-Downlink: A History of the Deep Space Network 1957-1997*. NASA SP-2001-4227, 2001.
- Dawson, Virginia P. and Mark D. Bowles. *Taming Liquid Hydrogen: The Centaur Upper Stage Rocket, 1958-2002*. NASA SP-2004-4230, 2004.

Center Histories, NASA SP-4300

- Rosenthal, Alfred. *Venture into Space: Early Years of Goddard Space Flight Center*. NASA SP-4301, 1985.
- Hartman, Edwin P. *Adventures in Research: A History of Ames Research Center, 1940-1965*. NASA SP-4302, 1970.
- Hallion, Richard P. *On the Frontier: Flight Research at Dryden, 1946-1981*. NASA SP-4303, 1984.
- Muenger, Elizabeth A. *Searching the Horizon: A History of Ames Research Center, 1940-1976*. NASA SP-4304, 1985.

Hansen, James R. *Engineer in Charge: A History of the Langley Aeronautical Laboratory, 1917-1958*. NASA SP-4305, 1987.

Dawson, Virginia P. *Engines and Innovation: Lewis Laboratory and American Propulsion Technology*. NASA SP-4306, 1991.

Dethloff, Henry C. "*Suddenly Tomorrow Came . . .*": *A History of the Johnson Space Center*. NASA SP-4307, 1993.

Hansen, James R. *Spaceflight Revolution: NASA Langley Research Center from Sputnik to Apollo*. NASA SP-4308, 1995.

Wallace, Lane E. *Flights of Discovery: 50 Years at the NASA Dryden Flight Research Center*. NASA SP-4309, 1996.

Herring, Mack R. *Way Station to Space: A History of the John C. Stennis Space Center*. NASA SP-4310, 1997.

Wallace, Harold D., Jr. *Wallops Station and the Creation of the American Space Program*. NASA SP-4311, 1997.

Wallace, Lane E. *Dreams, Hopes, Realities: NASA's Goddard Space Flight Center, The First Forty Years*. NASA SP-4312, 1999.

Dunar, Andrew J., and Stephen P. Waring. *Power to Explore: A History of the Marshall Space Flight Center*. NASA SP-4313, 1999.

Bugos, Glenn E. *Atmosphere of Freedom: Sixty Years at the NASA Ames Research Center*. NASA SP-2000-4314, 2000.

Schultz, James. *Crafting Flight: Aircraft Pioneers and the Contributions of the Men and Women of NASA Langley Research Center*. NASA SP-2003-4316, 2003.

Bowles, Mark D. *Science in Flux: NASA's Nuclear Program at Plum Brook Station, 1955-2005*. NASA SP-2006-4317, 2006.

General Histories, NASA SP-4400

Corliss, William R. *NASA Sounding Rockets, 1958-1968: A Historical Summary*. NASA SP-4401, 1971.

Wells, Helen T., Susan H. Whiteley, and Carrie Karegeannes. *Origins of NASA Names*. NASA SP-4402, 1976.

Anderson, Frank W., Jr. *Orders of Magnitude: A History of NACA and NASA, 1915-1980*. NASA SP-4403, 1981.

Sloop, John L. *Liquid Hydrogen as a Propulsion Fuel, 1945-1959*. NASA SP-4404, 1978.

Roland, Alex. *A Spacefaring People: Perspectives on Early Spaceflight*. NASA SP-4405, 1985.

Bilstein, Roger E. *Orders of Magnitude: A History of the NACA and NASA, 1915-1990*. NASA SP-4406, 1989.

Logsdon, John M., editor, with Linda J. Lear, Jannelle Warren-Findley, Ray A. Williamson, and Dwayne A. Day. *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Volume I, Organizing for Exploration*. NASA SP-4407, 1995.

Logsdon, John M., editor, with Dwayne A. Day and Roger D. Launius. *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Volume II, Relations with Other Organizations*. NASA SP-4407, 1996.

Logsdon, John M., editor, with Roger D. Launius, David H. Onkst, and Stephen J. Garber. *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Volume III, Using Space*. NASA SP-4407, 1998.

Logsdon, John M., general editor, with Ray A. Williamson, Roger D. Launius, Russell J. Acker, Stephen J. Garber, and Jonathan L. Friedman. *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Volume IV, Accessing Space*. NASA SP-4407, 1999.

Logsdon, John M., general editor, with Amy Paige Snyder, Roger D. Launius, Stephen J. Garber, and Regan Anne Newport. *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Volume V, Exploring the Cosmos*. NASA SP-2001-4407, 2001.

Siddiqi, Asif A. *Challenge to Apollo: The Soviet Union and the Space Race, 1945–1974*. NASA SP-2000-4408, 2000.

Hansen, James R., editor. *The Wind and Beyond: Journey into the History of Aerodynamics in America, Volume 1, The Ascent of the Airplane*. NASA SP-2003-4409, 2003.

Monographs in Aerospace History, NASA SP-4500

Launius, Roger D. and Aaron K. Gillette, compilers, *Toward a History of the Space Shuttle: An Annotated Bibliography*. Monograph in Aerospace History, No. 1, 1992.

Launius, Roger D., and J. D. Hunley, compilers, *An Annotated Bibliography of the Apollo Program*. Monograph in Aerospace History, No. 2, 1994.

Launius, Roger D. *Apollo: A Retrospective Analysis*. Monograph in Aerospace History, No. 3, 1994.

Hansen, James R. *Enchanted Rendezvous: John C. Houbolt and the Genesis of the Lunar-Orbit Rendezvous Concept*. Monograph in Aerospace History, No. 4, 1995.

Gorn, Michael H. *Hugh L. Dryden's Career in Aviation and Space*. Monograph in Aerospace History, No. 5, 1996.

Powers, Sheryll Goecke. *Women in Flight Research at NASA Dryden Flight Research Center, from 1946 to 1995*. Monograph in Aerospace History, No. 6, 1997.

Portree, David S. F. and Robert C. Trevino. *Walking to Olympus: An EVA Chronology*. Monograph in Aerospace History, No. 7, 1997.

Logsdon, John M., moderator. *Legislative Origins of the National Aeronautics and Space Act of 1958: Proceedings of an Oral History Workshop*. Monograph in Aerospace History, No. 8, 1998.

Rumerman, Judy A., compiler, *U.S. Human Spaceflight, A Record of Achievement 1961–1998*. Monograph in Aerospace History, No. 9, 1998.

Portree, David S. F. *NASA's Origins and the Dawn of the Space Age*. Monograph in Aerospace History, No. 10, 1998.

Logsdon, John M. *Together in Orbit: The Origins of International Cooperation in the Space Station*. Monograph in Aerospace History, No. 11, 1998.

Phillips, W. Hewitt. *Journey in Aeronautical Research: A Career at NASA Langley Research Center*. Monograph in Aerospace History, No. 12, 1998.

Braslow, Albert L. *A History of Suction-Type Laminar-Flow Control with Emphasis on Flight Research*. Monograph in Aerospace History, No. 13, 1999.

- Logsdon, John M., moderator. *Managing the Moon Program: Lessons Learned From Apollo*. Monograph in Aerospace History, No. 14, 1999.
- Perminov, V. G. *The Difficult Road to Mars: A Brief History of Mars Exploration in the Soviet Union*. Monograph in Aerospace History, No. 15, 1999.
- Tucker, Tom. *Touchdown: The Development of Propulsion Controlled Aircraft at NASA Dryden*. Monograph in Aerospace History, No. 16, 1999.
- Maisel, Martin D., Demo J. Giulianetti, and Daniel C. Dugan. *The History of the XV-15 Tilt Rotor Research Aircraft: From Concept to Flight*. NASA SP-2000-4517, 2000.
- Jenkins, Dennis R. *Hypersonics Before the Shuttle: A Concise History of the X-15 Research Airplane*. NASA SP-2000-4518, 2000.
- Chambers, Joseph R. *Partners in Freedom: Contributions of the Langley Research Center to U.S. Military Aircraft in the 1990s*. NASA SP-2000-4519, 2000.
- Waltman, Gene L. *Black Magic and Gremlins: Analog Flight Simulations at NASA's Flight Research Center*. NASA SP-2000-4520, 2000.
- Portree, David S. F. *Humans to Mars: Fifty Years of Mission Planning, 1950–2000*. NASA SP-2001-4521, 2001.
- Thompson, Milton O., with J. D. Hunley. *Flight Research: Problems Encountered and What They Should Teach Us*. NASA SP-2000-4522, 2000.
- Tucker, Tom. *The Eclipse Project*. NASA SP-2000-4523, 2000.
- Siddiqi, Asif A. *Deep Space Chronicle: A Chronology of Deep Space and Planetary Probes, 1958–2000*. NASA SP-2002-4524, 2002.
- Merlin, Peter W. *Mach 3+: NASA/USAF YF-12 Flight Research, 1969–1979*. NASA SP-2001-4525, 2001.
- Anderson, Seth B. *Memoirs of an Aeronautical Engineer—Flight Tests at Ames Research Center: 1940–1970*. NASA SP-2002-4526, 2002.
- Renstrom, Arthur G. *Wilbur and Orville Wright: A Bibliography Commemorating the One-Hundredth Anniversary of the First Powered Flight on December 17, 1903*. NASA SP-2002-4527, 2002.
- No monograph 28.
- Chambers, Joseph R. *Concept to Reality: Contributions of the NASA Langley Research Center to U.S. Civil Aircraft of the 1990s*. NASA SP-2003-4529, 2003.
- Peebles, Curtis, editor. *The Spoken Word: Recollections of Dryden History, The Early Years*. NASA SP-2003-4530, 2003.
- Jenkins, Dennis R., Tony Landis, and Jay Miller. *American X-Vehicles: An Inventory—X-1 to X-50*. NASA SP-2003-4531, 2003.
- Renstrom, Arthur G. *Wilbur and Orville Wright: A Chronology Commemorating the One-Hundredth Anniversary of the First Powered Flight on December 17, 1903*. NASA SP-2003-4532, 2002.
- Bowles, Mark D. and Robert S. Arrighi. *NASA's Nuclear Frontier: The Plum Brook Research Reactor*. NASA SP-2004-4533, 2003.
- Matranga, Gene J., Wayne C. Ottinger, Calvin R. Jarvis, and Christian D. Gelzer. *Unconventional, Contrary, and Ugly: The Lunar Landing Research Vehicle*. NASA SP-2006-4535, 2006.

McCurdy, Howard E. *Low Cost Innovation in Spaceflight: The History of the Near Earth Asteroid Rendezvous (NEAR) Mission*. NASA SP-2005-4536, 2005.

Seamans, Robert C. Jr. *Project Apollo: The Tough Decisions*. NASA SP-2005-4537, 2005.

Lambright, W. Henry. *NASA and the Environment: The Case of Ozone Depletion*. NASA SP-2005-4538, 2005.

Chambers, Joseph R. *Innovation in Flight: Research of the NASA Langley Research Center on Revolutionary Advanced Concepts for Aeronautics*. NASA SP-2005-4539, 2005.

Phillips, W. Hewitt. *Journey Into Space Research: Continuation of a Career at NASA Langley Research Center*. NASA SP-2005-4540, 2005.

Electronic Media, SP-4600 Series

Remembering Apollo 11: The 30th Anniversary Data Archive CD-ROM. NASA SP-4601, 1999.

The Mission Transcript Collection: U.S. Human Spaceflight Missions from Mercury Redstone 3 to Apollo 17. NASA SP-2000-4602, 2001, CD-ROM.

Shuttle–Mir: The United States and Russia Share History’s Highest Stage. NASA SP-2001-4603, 2002, CD-ROM.

U.S. Centennial of Flight Commission presents Born of Dreams–Inspired by Freedom. NASA SP-2004-4604, 2004, DVD data disk.

Of Ashes and Atoms: A Documentary on the NASA Plum Brook Reactor Facility. NASA SP-2005-4605, DVD video.

Taming Liquid Hydrogen: The Centaur Upper Stage Rocket Interactive CD-ROM. NASA SP-2004-4606, 2004.

Fueling Space Exploration: The History of NASA’s Rocket Engine Test Facility DVD. NASA SP-2005-4607, DVD video.

Conference Proceedings, SP-4700 Series

Dick, Steven J. and Keith L. Cowing, ed. *Risk and Exploration: Earth, Sea and the Stars*. NASA SP-2005-4701.

Dick, Steven J. and Roger D. Launius. *Critical Issues in the History of Spaceflight*. NASA 20064702.